WRITTEN STATEMENT
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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)
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Thank you, Mr. Chairman and Members of the Committee, for the opportunity to testify before you regarding National Oceanic and Atmospheric Administration's (NOAA) satellite, data and information services. Vice Admiral Conrad C. Lautenbacher is unable to attend this hearing today due to prior commitments. I am Gregory Withee, Assistant Administrator for NOAA's Satellite and Information Services and am responsible for end-to-end management of NOAA's satellite, data and information programs.

NOAA's satellite program is well on its way to addressing the exciting challenge of incorporating new technologies to improve the capabilities of our operational satellite systems to better serve the American people. My testimony today will review the steps we are taking and the lessons learned over the past 43 years as the Nation's operational civil space agency. It will lay out our plans for satellite data continuity as we move to the first National Polar-orbiting Operational Environmental Satellite System (NPOESS) spacecraft, the follow-on to the NOAA Polar-orbiting Operational Environmental Satellite (POES). The first NPOESS satellite (C-1) will be available for launch in 2009 and will continue our polar satellite data series, as well as provide important continuity for select National Aeronautics and Space Administration (NASA) research missions and climate activities. I will also address our plans for the next series of Geostationary Operational Environmental Satellites (GOES) - GOES-R - with a planned launch date of 2012.

While these dates seem very far in the future, our experience developing, launching and operating environmental satellites dictates that early planning, accompanied by rigorous risk-reduction activities, is essential. Equally important is the thorough preparation of the end-user to accept, use and benefit from the full economic and scientific value of these data streams, and the establishment of a comprehensive scientific data stewardship program that includes long-term access and archive infrastructure.

This Subcommittee has been a strong advocate of our programs, and we look forward to continuing the dialogue to keep you informed of our progress.

NOAA’s Satellite, Data and Information Program

Since the 1960s, when the United States launched its first civil polar-orbiting weather satellite (1960) and its first civil geostationary weather satellite (1966), the importance of data from these satellite systems has grown far beyond any planning assumptions made during their conception in the 1950's. Today, NOAA’s satellites support all of NOAA’s critical missions; numerous civil and military activities within Federal, state and local government agencies; academic endeavors; the private sector activities; the public; and international communities. NOAA’s satellites are critical for all sectors of the U.S. economy, and are now considered environmental versus just weather satellites.

NOAA’s mandate is to provide to its customers and users - without interruption - satellite data from its geostationary and polar-orbiting systems. As we move to the next generation of satellites, our operational mission requires that GOES-R and NPOESS are available to ensure continuous global satellite coverage essential to ensure the health and safety of our citizens. Additionally, these satellites provide data critical to unlocking the secrets of nature which are fundamental to our ability to reduce the uncertainties in important environmentally related decisions associated with long-term forecasts and global climate change.

NOAA’s policy implements this mandate through a carefully planned and balanced requirements-based acquisition strategy which is detailed in the annual President’s Budget Request. These budget requests include the annual funding required to enable NOAA to manage the technology and schedule risk inherent in these challenging satellite programs.

Requirements-based Mission Planning

NOAA uses a formal satellite requirements management process to identify, collect and assess validated environmental satellite observation requirements and allocate these requirements to specific observational systems. These requirements include satellite-based observations of all regions of the Earth’s atmosphere; the Earth’s oceans, coasts, and inland waters; observations of the Earth’s land masses, including the mapping of high-resolution geospatial characteristics; and observations of the sun and near-Earth space environment.

This process provides important input into budget, planning, and management systems, and allows tracking of requirements from agency missions through to system allocations. As such, this process and its requirements documents represent the balance achieved among user needs, system technical capabilities and program affordability constraints. The credibility of the requirements process lies in the ability of this planning document to fulfill user needs within cost and schedule. This process has been used to develop the instrument and sensor suite on the GOES-R and NPOESS satellites.

The GOES-R Program Requirements Document (PRD) represents twelve agencies/groups needs from the U.S. civil, U.S. military, European and climate communities. The specific segment level documents to address all specifications for the end-to-end GOES-R system will be generated from the PRD.

For NPOESS, the Department of Defense (DoD) requirements process was used by the partner agencies (NOAA, DoD, and NASA) to develop an Integrated Operational Requirements Document (IORD). All three agencies worked with their user and customers throughout the Federal, state and local governments, academia, and industry to develop inputs into the mission and sensor performance requirements. The original IORD was approved by all agencies in 1996 and updated in December 2001. All sensors are traceable to specific requirement for one or all of the partner agencies. In many cases, a single sensor is required to meet different but equally important requirements of all three agencies and their customers and users.

Scientific Data Stewardship of NOAA's Archives

The concept of end-to-end management starts with the requirements process and ends with the access and archive of these data. NOAA continues to keep its data access and archive facilities at its NOAA National Data Center current with the latest technology to facilitate user access to its archived data.

NOAA Satellites and Information FY2004 President's Budget Request

All aspects of the $837.5 million in the FY2004 President's Budget Request have been carefully developed to ensure continuation of our existing operational programs, allow seamless transition to future satellite and data management activities, and satellite data continuity. Our partners - NASA and DoD - have worked with us to help manage the risk, schedule and funding estimates required to support the activities necessary to develop and launch the satellites and build the ground systems needed to maintain data continuity. The FY 2004 budget request will allow us to continue essential activities in support of GOES, POES, NPOESS, critical support for command and control of the spacecraft, product processing and distribution, and data management including access and archive functions.

NOAA Geostationary Program

The FY2004 President's Budget Request includes $277.55 million NOAA's GOES program. Of that amount, $0.6 million to support GOES I-M activities; $172.23 million to continue development of GOES N series satellites and ground systems; and $104.7 million to support GOES-R preliminary design and risk reduction activities.

NOAA is responsible for the end-to-end aspects of the GOES program. NOAA's constellation of two operational GOES satellites and one on-orbit spare now provide continuous coverage of the Western Hemisphere, seeing as far east as the western tip of Africa and as far west as the eastern tip of New Guinea. These geostationary sentinels provide critical data to weather forecasters, and detect and track severe weather, such as tornados, hurricanes, flash floods, blizzards and other hazards (to include volcanic ash plumes and wildland fires). In addition, GOES data collection system (GOES DCS) platforms provide communication data relay capabilities for scientific surface platforms such as automated observing stations, ocean buoys, stream gauges, tide gauges, and rain gauges. The system relays environmental information such as river flooding, snow melt, ocean temperature, and wind measurements to forecasters and emergency managers. GOES also monitors space weather events such as radiation and geomagnetic storms though the Space Environment Monitoring sensors.

NOAA has a requirement to maintain two operational GOES satellites, one at 75 degrees West longitude (GOES-East) and another at 135 degrees West longitude (GOES-West). In order to ensure that a two GOES constellation is continuously available, an on-orbit stored spare is required. NOAA launches a replacement satellite once the on-orbit spare is placed into operation. NOAA also requires that a satellite be ready for launch within a year of the previous satellite launch to back-up a launch failure. The placement of the operational satellites ensures continuous satellite coverage of U.S. interests on the East Coast, its territories in the Caribbean Basin and continental U.S., and West Coast, Hawaii, and U.S. territories in the Pacific.

This constellation is based on over 40 years of experience and our understanding of satellite and launch performance and incorporates the lessons learned from past future development.

First, launch of the satellite is the most vulnerable part of the entire mission from production to operational use. NOAA maintains an on-orbit spare, so it can recover quickly from a launch failure. This approach allows NOAA to replan another launch campaign, thus avoiding an extended outage in our on-orbit two operational satellite constellation. This was not possible when GOES failed on launch in 1986, resulting in one-satellite geostationary coverage for many years.

Second, having an on-orbit spare allows rapid replacement on failure of an operational satellite and ensures “no loss” of coverage or data for users in the event of a failure of one of the GOES operational satellites. By activation of the on-orbit spare, NOAA can restore full instrument operations and data within 7 days of failure of the previous satellite, and provide continuous data during the approximately 30-45 days it takes to move the spacecraft from the storage location to the operational location, as either GOES-East or GOES-West. Key users - NOAA’s National Weather Service, Department of Defense, Federal Emergency Management Agency/Department of Homeland Security, state and local emergency managers, Federal Aviation Administration - demand uninterrupted access to satellite data to support their mission-critical activities.

Third, NOAA can perform systematic on-orbit post-launch testing of the spacecraft and instruments to ensure that instruments are performing according to specifications and will meet customer and user requirements. This on-orbit testing is a more complete evaluation of performance than is achievable on the ground. The approach of systematic on-orbit testing prior to putting a satellite into on-orbit storage also allows a more thorough investigation of, and if necessary, appropriate corrective action of anomalies without the pressures of meeting an operations schedule. A prime example of NOAA's recovering of potentially failed assets was GOES-10 and its failed solar-array drive in the forward direction. Creative engineering solutions allowed GOES-10 to become our operational West satellite in July 1998 which continues to the present.

Finally, having an on-orbit space can avoid launch pad conflicts. Due to limited launch facilities and NOAA's use of commercial launch services, if NOAA were to experience a failure during launch, it would take 12-18 months for the earliest possible launch of a replacement satellite because of existing commercial launch pad schedules. Commercial launch schedules maintain a rolling firm launch manifest of 12-18 months into the future. By Congressional directive, commercial launch services for NOAA programs require a rigorous process before NOAA could "bump" another commercial customer off the manifest. NOAA's launch policy avoids having to address this situation. Only under a multiple failure scenario would NOAA ever consider bumping another customer.

The GOES I-M Experience

In 1983, a decision was made to competitively procure follow-on satellites (GOES I-M) in the GOES program. Incremental changes to requirements were deemed achievable, with the only major advancement being a new requirement for full-time atmospheric sounding to monitor evolving temperature and moisture structure of the atmosphere to meet validated NOAA's National Weather Service requirements. This new requirement drove a design change in the basic spacecraft platform requiring full time Earth pointing versus the previous spin stabilized platform design. The satellite contract called for a launch availability in 1989. This need date was originally anticipated to protect against a GOES-G or GOES-H launch failure.

The new technology had no risk reduction program associated with it on the basis that instruments of this type had been flown in polar orbit, making the transition to geostationary orbit reasonably straightforward. It also assumed that the body stabilized technology had been proven sufficiently on geostationary commercial communication satellites.

The instrument and spacecraft development were found to be much more technically complex than originally thought, once the design was finalized. Changes in thermal characteristics between the polar and the geostationary orbit were not fully understood, and the original design for the instruments was found, in tests, not to work. On the spacecraft, stabilization for meteorological instruments was far more challenging than for a commercial communications platform. These problems led to almost five additional years of design effort and a billion dollar overrun.

Since GOES I-M Series had no end-to-end system architecture, no risk reduction was planned for algorithm development and data assimilation into numerical models. Therefore, the forecasters had no advance data, prior to launch, with which to learn and train and NOAA's National Weather Service required the better part of a year to make the image data operational, and almost four years to make the sounder data operational in forecast offices.

With the failure of one on-orbit GOES and a failure in 1986, by 1989 (the intended launch date of GOES-I), only one GOES satellite separated the United States from being completely unable to provide high temporal resolution monitoring of hurricanes at an early stage, monitor severe weather wherever it occurred, and miss important sounding information for short-term weather forecasts and warnings. This situation continued until GOES-I was launched in 1994.

GOES-R Planning

In response to validated user requirements for improved geostationary spatial and temporal observations, NOAA has started planning activities for the GOES-R series which is anticipated to launch its first satellite by 2012. History and experience have shown that it takes 10 years to develop a new satellite series. NOAA and our partner NASA have learned that environmental sensors for geostationary orbit are difficult to develop and build, and need the full 10 years for development, even with the excellent research provided through NASA or DoD. The GOES I-M and GOES-N series instrument technologies were first developed in the 1970's/80's. While they have served the Nation well, our customers' and users' validated requirements for data are beyond the capability that these heritage instruments can provide.

NOAA has incorporated the experiences of GOES I-M into GOES-R planning with the inclusion of rigorous and comprehensive concept, design, and risk reduction phases which includes an end-to-end system with its associated product generation, distribution, and archive and access. GOES-R is scheduled for readiness to back up the development of the last GOES-N series launch in 2012.

GOES-R will, for the first time, offer further benefits for other observations such as coastal and lightning data, provide improvements in spectral coverage (number of instrument channels), temporal coverage (how fast the satellite scans the Earth), spatial resolution (how sharp the images are horizontally for images and vertically for temperature and moisture profiles), and radiometric accuracy (how true are the temperatures measured). These improvements translate to product improvements such as 3-hour temperature forecasts (25% accuracy improvement) and Atmospheric Instability forecasts (90% improvement in 2-hour ahead Convective Weather watch area) which in turn are important to utility, transportation, agriculture, recreation, and other industries, and are vital to protecting lives and property in the event of severe weather. Preliminary estimates place the incremental benefits of the improvements from the GOES-R series of satellites at more than $4 billion over the life of the program. These benefits are in addition to the baseline benefits that the current GOES satellites provide.

In order to ensure a smooth transition from the GOES-N to the GOES-R series, NOAA needs to have all phases of a sound acquisition development in place: Phase A (Concept Definition);

Phase B (Design and Risk Reduction); Phase C/D (System Production/Implementation). In the case of GOES I-M, the Phases A and B efforts were omitted. The result of skipping these key functions resulted in a 5-year slip in the program with significant cost overruns.

To address alternative approaches to end-to-end solutions for GOES-R, NOAA is releasing to industry a Broad Agency Announcement to look at technology advancements in the following four areas: spacecraft; command, control, and communications; product generation, distribution, archive and access; and end-to-end systems integration. This will afford NOAA the opportunity to dialogue with industry to entertain their best and brightest ideas to minimize risk during GOES-R development.

Full funding of the FY2004 GOES-R budget request of $104.7 million is needed to continue these activities and strengthen the overall risk reduction program to ensure that NOAA is developing the most appropriate system to meet our operational requirements and program funding constraints, and that NOAA will have retired sufficient risk to ensure that the GOES-R system is delivered on time to support the continuity of the essential GOES mission.

NOAA's Polar-orbiting Satellite Program

The FY2004 President's Budget Request includes $391.1 million NOAA's polar-orbiting satellite program. Of that amount, $114.4 million is requested for POES satellites (NOAA K-N' series) and ground systems; and $276.7 million for NOAA's portion of NPOESS.

a) Polar-orbiting Operational Environmental Satellites (POES)

The POES mission is to provide an uninterrupted flow of global environmental information in support of operational requirements. The POES mission is comprised of two satellites, one in a morning orbit, and one in an afternoon orbit, to collect global environmental data, including the 3-D measurement of multiple parameters, which are critical for accurate forecasts beyond three days. In addition, they are important for establishing long-term global data sets for climate (stratospheric ozone, oceanic, vegetation, global warming) monitoring, change detection, and prediction. Data sparse areas such as the world's oceans are also observed primarily by NOAA POES. Like GOES, POES data collection platforms provide services such as search and rescue, and relay of tide, buoy, flood, and tsunami data from global and remote locations. POES sensors also make observations that support timely forecast of space weather events.

NOAA has established a POES program policy that a spacecraft and launch vehicle be available on or before the date of the launch of the preceding spacecraft. This helps protect against coverage gaps caused by a launch failure, early on-orbit failure of the satellite after launch, and sets a need-date for the next satellite to be produced.

In the scenario of NOAA N' failure and lack of access to timely backup, DoD, research, and international satellite data, significant impact to protection of life and property and climate monitoring services are possible. Potential impacts include degradation of hazard monitoring such as volcanoes, especially at high latitudes; breaks in the climate record which degrade the long-term climate record; loss of the ability to generate ozone and ultraviolet (UV) analyzes and forecasts used for public heath; and decreased forecast accuracy in global models, estimated to be 1-4% in Northern Hemisphere and 3-25% in the Southern Hemisphere.

The annual President's Budget Request is based on the anticipated need-date of the satellites. However, depending on launch success, and operational satellite life, these need dates may shift. Nominally, the time between call-up and the actual replacement of a POES is 180 days.

The normal replacement of a POES takes place whenever the flow of operational scientific and related instrument engineering data from designated critical satellite instruments is either interrupted or degraded significantly. In practice, any decision to launch a replacement satellite requires the consideration of several additional factors, such as: availability of older POES spacecraft in the orbit with functioning instrument(s) that can provide data continuity on an interim basis; operational condition of in-orbit NOAA POES spacecraft, in particular are other spacecraft or instruments displaying indications of early failure; availability of launch vehicles and spacecraft-to-launch vehicle integration facilities; the possibility of conflicts in access to launch pads and launch support facilities; the possibility of conflicts in availability of skilled personnel for launch preparations and other critical activities; ability of the ground system to support the launch, operations, and data processing and distribution for the replacement satellite.

b. National Polar-orbiting Operational Environmental Satellite System (NPOESS)

In May 1994, the President directed the convergence of the Department of Commerce/NOAA POES program and DoD's Defense Meteorological Satellite Program (DMSP). These two programs have joined to become the NPOESS which will satisfy both civil and national security operational requirements. In addition, NASA, through its Earth Observing System (EOS) efforts, offers new remote-sensing and spacecraft technologies that are being incorporated to improve the capabilities of the NPOESS.

The tri-agency NPOESS Integrated Program Office (IPO) and NPOESS contractor has established a design and production schedule to derive the maximum benefit from the risk-reduction missions of the NPOESS Preparatory Project (NPP) and the Windsat/Coriolis mission for critical risk reduction for the NPOESS C-1 satellite. The schedule will also provide a bridge between the transition from NOAA POES and DoD DMSP satellites, while providing continuity of select NASA EOS missions.

NPOESS FY2004 Budget Request

The FY 2004 President's Budget Request for NPOESS is $544.4 million, of which DOC/NOAA's portion is $276.7 million, and DoD's portion is $267.7 million. This will support continued development of NPOESS, including the risk reduction missions, Windsat/Coriolis and NPP.

In the letter of invitation to testify at this hearing, the Subcommittee asked for a response to the $70 million reduction from the funding requirements included in the FY2003 estimates. The FY2004 President's Budget Request reflects the Administration's program needs for continued development of the NPOESS Program. IPO has directed the NPOESS contractor to conduct a replan, which resulted in deferred procurement of sensors and non-recurring engineering for NPP and the NPOESS satellites. Adjustments to the satellite launch schedule are reflected in the President's Budget Request.

Full funding of the total DOC and DoD NPOESS FY2004 President's Budget Request is imperative to keep the program on its revised schedule.

NPOESS Risk Reduction Missions

The WindSat/Coriolis satellite, which was launched on January 6, 2003, is serving as risk reduction for the NPOESS Conical Scanning Microwave Imager/Sounder (CMIS). CMIS will measure ocean surface wind direction from space using polarimetic passive microwave technology, which requires a sensor with the capability to sense passive microwave emissions that are on the order of one-tenth as strong as the signals used by presently operational passive microwave sensors. This has not been done before from space and constitutes the highest technical risk associated with NPOESS.

The NPP satellite scheduled for launch in October 2006 will significantly reduce NPOESS program risks by demonstrating on-orbit sensor functionality and allowing scientists to develop NPOESS algorithms using data collected by actual sensors on-orbit instead of having to approximate data through synthetic generation as is usually done for new sensors. History demonstrates that the risk associated with advances in algorithm developments is dominated by how accurately the data used to develop the algorithms resemble the data that will be collected by the sensor on-orbit. This rationale applies to the following NPOESS sensors and their associated algorithms.

- Cross Track Infrared Sounder – 3 environmental data records (EDR)
- Visible/Infrared Radiometer Suite – 23 EDR
- Advanced Technology Microwave Sounder – 3 EDR
- Ozone Mapping and Profiling Suite – 1 EDR

NPP will also demonstrate proper functioning of the NPOESS Command and Control System

Transition between POES and NPOESS satellites

The Subcommittee's letter of invitation also expressed interest in the transition between POES and NPOESS, specifically an estimated 21-month gap between the launch of NOAA N' and the availability of NPOESS C-1.

As a polar-orbiting satellite program, the NPOESS satellite availability strategy is similar to that noted earlier for NOAA POES with the additional constraints of required overlap with NPP for cross calibration and meeting the DoD early morning spacecraft requirement. Under the IORD, the first NPOESS satellite (C-1) is required to back up NOAA N' (the last of the NOAA POES series) or DMSP F20. While the replan has delayed the availability of the first NPOESS satellite by as much as 21 months, there is no projected gap in coverage, as long as the NOAA N and N' satellites are successfully launched, and are meeting operational lifetimes.

NOAA continues to monitor the status of the instruments on its operational POES to maximize the capability of those spacecraft. Our transition planning calls for the launch of the NOAA N (June 2004) and NOAA N' (March 2008) into the afternoon orbit and the use of the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) METOP polar satellite to fill the morning orbit requirement.

With respect to the Subcommittee's interest in contingency planning in the event of the failure of NOAA N', NOAA is working closely with EUMETSAT to ensure launch of the first METOP satellite in 2005 which will assume the morning orbit responsibilities. In the event there is a loss of NOAA N' prior to the launch of NPOESS C-1, NOAA would rely on the METOP satellite in the morning orbit.

For the afternoon orbits, NOAA would reassess the capability of older spacecraft that have been taken out of operational service and use the best available data. NOAA would also assess the utility of all available satellite data from DoD's DMSP, NASA EOS satellites, NPP missions, and foreign sources.

Status of the NPOESS Program Sensors

The Subcommittee has expressed an interest in any cost-savings that may be accrued from reducing the NPOESS sensors and impact this would have on meeting operational requirements.

The NPOESS Program Office, in consultation with the NPOESS Program Executive Committee, reviewed the status of the program, the FY2003 Appropriations, FY2004 budget request against the operational requirements in the IORD and satellite schedule. They determined that there will be no changes to the technical content of the program, specifically the number and types of sensors and their performance, the number of satellites, number of weather centrals. The NPOESS Program recommended, and the Committee approved, adjustments to the schedule to accommodate the available funds. The basis of the recommendation was that no single sensor, even if totally deleted, would provide significant reduction in the overall program cost. Additionally, the impact to the customer of the loss of data and services if sensors were reduced would be incalculable. Appendix 1 contains a list of the NPOESS sensor suite.

For illustrative purposes, the following is a review of the impact of deleting the Visible/Infrared Imaging Radiometer Suite (VIIRS) and the Conically-scanned Microwave Imager Sounder (CMIS) from the NPOESS sensor suite. VIIRS is designed to meet NOAA and DoD operational requirements and to continue the NASA EOS Moderate Resolution Imaging Spectroradiometer (MODIS) data to meet the climate community imagery requirements, provide continuity of the Sea-viewing, Wide-Field-of-view Sensor (SeaWiFS) instrument for ocean color, and provide enhancement on heritage NOAA POES and DMSP sensors. SeaWiFS data continuity is a critical requirement for the ocean sciences community.

CMIS is used to image the Earth's surface through clouds, which is especially important for sea and lake ice, for ocean surface wind speed and direction, and for soil moisture measurements (a key performance parameter from the DoD and useful for civilian agricultural and flood warning applications). The development costs of the VIIRS visible and infrared imager and the CMIS are approximately $180 million for each sensor suite. This amount includes three VIIRS sensors (NPOESS Preparatory Project, NPOESS C-1 and C-2), two CMIS sensors (NPOESS C-1 and C-2), and all the algorithms and software for both. Development of the sensors is far enough along that there would be no program cost savings from reducing the number or type of sensors from the NPOESS Program. In fact, deleting the VIIRS sensor eliminates all the imaging capability from NPP, C-1 and C-2. This would negate two thirds of the EDRs on NPOESS and result in NPOESS' inability to meet IORD performance requirements.

During the assessment to converge DMSP and POES into NPOESS, NOAA and DoD conducted cost benefit analyses and it was estimated that the program will realize cost avoidance of $1.3 billion over its life. Therefore, we have already realized a major cost benefit from effectively reducing the number of instruments in orbit. If further budget adjustments require that select sensors are dropped, NOAA would not be able to meet the mission requirements directed in the IORD.

NOAA would be affected more than DoD, since NOAA does have unique sensors such as Total Solar Irradiance Sensor (TSIS) and Earth Radiation Budget Sensor (ERBS) that do not meet DoD requirements, but do meet NASA and NOAA climate and scientific mission requirements. Removing any of the "critical" sensors, VIIRS, Cross-track Infrared and Microwave Sounding Suite (CrIS), Advanced Technology Microwave Sounder (ATMS), or CMIS, would result in violation of the key performance parameters of the IORD, which, according to DoD acquisition rules, could result in cancellation of the program. Since these sensors provide critical data for numerical forecasting to NOAA and the weather and climate community, the impacts would be significant and unacceptable.

Further, the near-term impact of the reduced funding results in loss of efficiency at the contractor facility, and instability in production schedules. The impact to the customer and user is an increased uncertainty whether they should develop programs based on the availability of NPOESS data. It also leads to inefficiencies in our customers' and users' readiness plans to invest in the critical information technology (IT) infrastructure required to facilitate use of NPP and NPOESS the data on "Day One of Its Availability."

NOAA's Preparations for NPOESS and GOES-R Data Streams

A discussion of NOAA's satellites and its preparation for future systems must also include the concept of end-to-end utilization of satellite data. As discussed at last year's hearing before this Subcommittee, NOAA is committed to ensuring that the data from NPP, NPOESS, and GOES-R will be incorporated into operations on the first day of its availability, and the academic community, industry, and other users will be able to access climate-quality data from NOAA's archive.

The President's FY2004 budget request contains $91.2 million to support our Environmental Observing Services. Within these amounts are activities designed to support current operations as well as prepare NOAA to utilize NPOESS and GOES-R satellite data on "Day One of Its Availability." A sampling of these activities include:

Use of Precursor NPOESS Sensors

NOAA has started to use and incorporate data from NASA EOS research instruments that are NPOESS precursor sensors (both sounders and imagers) into NOAA operations on a limited and experimental basis. As such, NOAA's National Weather Service, NOAA Oceans and Coasts, NOAA Research and other users are beginning to become familiar with the increased volume, variety, and complexity of the data. Indeed, already we have seen improvements in operations from these data and expect to realize further improvements as operators realize the full potential of the available data and make greater use of them.

NOAA has been systematically working on upgrading and enhancing current product development, processing and distribution capabilities to begin acquiring and exploiting in near real-time data from MODIS and Advanced Infrared Sounder (AIRS) on the NASA EOS Missions Terra and Aqua missions to directly support NOAA's operational missions that require remotely sensed data. Because the MODIS instrument is very similar to the VIIRS and the AIRS instrument is similar to CrIS that will be flown on the NPP mission and on the operational NPOESS spacecraft, these early NOAA efforts are critical to reduce the risk and gain experience with similar instruments; data handling, processing, storage, and communication of high volume data sets; and allow the users to gain early, pre-operational experience with NPP and NPOESS-like data sets, well before the first operational NPOESS spacecraft is launched.

Similar efforts are being pursued to build the capability to handle and process data from the future CMIS that will be flown on NPOESS to measure, among other parameters, the ocean surface vector wind field. Current efforts at NOAA (and the Navy) address the operational/tactical use of ocean surface vector winds from active scatterometer missions (e.g., SeaWINDS). Beginning with the launch of the joint DoD/DOC Windsat/Coriolis mission (a NPOESS risk reduction flight for the CMIS instrument), NOAA's processing capabilities for SeaWINDS will be transitioned to processing and utilizing data from the WindSat/Coriolis mission, in preparation for the first launch of NPOESS. Additional development work that is required to prepare for the NPOESS era will be performed in close cooperation with IPO and through the Joint Center for Satellite Data Assimilation, further described below.

Use of Surrogate Data Sources

NOAA actively assesses the utility of non-NOAA data to fill its mission. NOAA purchases data from Orbital Imaging to fulfill NOAA's operational requirement for ocean color data. NOAA also uses data from the joint NASA-European Space Agency's altimetry mission. These two cases are examples where NOAA has utilized alternate risk reduction activities to assess the utility of currently available data streams to support NOAA's missions prior to transitioning these capabilities onto NPOESS satellites.

Collaboration with the Science Community

In response to recommendations from the Chairman and this Subcommittee at last year's hearing, we continue to actively seek collaborative partnerships with Universities and the broader academic community to address meeting the need for science or climate research quality data from NPOESS and GOES-R missions. NOAA is harnessing the best and brightest minds to work with us. Highlights include:

- Establishment of the Cooperative Institute for Oceanographic Satellite Studies (CIOSS) with the College of Oceanic and Atmospheric Sciences (COAS) at Oregon State University. COAS is rated among the top five oceanographic institutions in the Nation by the National Research Council. This partnership between COAS and NESDIS builds on COAS' recognized leadership in the fields of oceanographic remote-sensing and coastal ocean research.

- Continued relationships with the Cooperative Remote Sensing Science and Technology Centers (CREST) located at the City University of New York (CUNY). CREST is a partnership among NOAA, CUNY, Hampton University, University of Puerto Rico at Mayaguez, University of Maryland at Baltimore County, Bowie State University, and Columbia University. In addition to training future remote-sensing scientists, students within the CREST consortium have already started rotations within NESDIS's science programs in Wisconsin and Maryland.

- Continued partnerships with University Corporation for Atmospheric Research (UCAR) and the National Center for Atmospheric Research (NCAR) in Boulder, Colorado.

- NOAA continues to harness the knowledge through existing collaborations at the Massachusetts Institute of Technology, University of Maryland, University of Wisconsin, University of Colorado, Colorado State University, and other academic institutions.

NOAA's Science Advisory Board (SAB) is considering the establishment of an NPOESS Science Panel to assist in these efforts.

Not only do these opportunities fertilize NOAA's scientific programs, they create a demand for young scientists to enter fields that are critical to NOAA's future to build a workforce with which NOAA can initiate personnel succession planning.

Satellite Data Assimilation - Joint Center for Satellite Data Assimilation (JCSDA)

The FY2004 President's Budget Request includes $3.35 million to support activities with JCSDA. NOAA appreciates the strong support this Subcommittee has provided for JCSDA. JCSDA, initially a partnership between NOAA and NASA, has been expanded to include DoD, and is addressing the development of common algorithms that will be used by all the NPOESS customers.

The goal of JCSDA is to make better use of all sources of satellite data in operations including preparing for, assimilating, and using data from NPOESS sensors. This will ensure that operational users are ready and eager to use NPOESS data ***on day one*** of its availability. We already have some positive results from these efforts, such as a better way to use satellite data to locate hurricane centers, but we need to continue this work with the brightest minds in our government and universities. Accomplishments of JCSDA in the past year include: committed partnership among NOAA Line Offices (NOAA's National Weather Service, NOAA Research, and NOAA Satellites and Information), DoD (US Air Force and US Navy), NASA, and the academic community; incorporation of EOS AIRS data into NOAA's National Weather Service models; upgraded communications lines between NASA and NOAA in order to move data to operations processing centers at NOAA; improved computing capacity.

JCSDA will also play a critical role in GOES-R risk reduction activities.

Information Technology Reviews

The NPOESS partners and NPOESS contractor continue to undertake rigorous reviews of IT infrastructure and capacity to support NPOESS data assimilation at the NPOESS operational centers. We recognize and constantly monitor IT advances to ensure that we are harnessing the best technology available to address the challenges before us in the most cost-effective way. As noted above, the ability to develop the appropriate IT infrastructure to ensure that ground and processing systems are ready in time for NPP and NPOESS depends on available funding.

Partnerships with other Space Agencies

In addition to NASA, DoD, academia, and industry, NOAA continues to develop and nurture critical partnerships with foreign space agencies in Japan, China, India, and Europe, (such as France, Italy and Russia). These partnerships allow us to leverage select data from these satellite systems at tremendous cost savings to the U.S. taxpayer by not flying duplicative satellites and sensors on NOAA spacecraft.

User Training and Education, and Public Outreach

NOAA continues to work with UCAR, the American Meteorological Society (AMS), DoD and other partners to develop and implement teaching modules for operational users regarding applications of NOAA satellite data in the classroom and through distance-learning such as E-learning. NPOESS and GOES-R will use these avenues to ensure that operators are ready and able to use satellite data from those systems when they become available. NOAA anticipates that advances in IT and E-learning will provide opportunities to increase training in the future. NOAA has also sponsored a number of national and international user workshops and meetings to discuss the NPOESS and GOES-R programs.

NOAA's Satellite Data Access and Archive

The NOAA National Data Centers - located in Maryland, Colorado, North Carolina and Mississippi - routinely incorporate the latest technologies to facilitate rapid and easy user access to the data, products, and information under NOAA's stewardship. The President's FY2004 budget request of $59.074 million for NOAA data centers and information services continues the work to ensure that these invaluable data are available for many generations.

The IT revolution is changing the expectations and demands that customers have for access and use of observations, data, information, products, and services. Customers are now able to transfer and process vast quantities of data and expect easy and efficient web-based access and search capabilities via the worldwide web and broadband Internet. Entrepreneurs in the application of information and intellectual property are finding numerous innovative applications for NOAA data and information. This in turn, is driving the NOAA data centers to provide more rapid access, more timely and improved quality assurance and quality control of these data. The objective NOAA "quality assurance" stamp is critical to private industry and decision-makers who require confidence in the data when considering capital investments and annual business plans, as well as long-term policies.

In anticipation of the increases in data from NASA EOS, NPP, NPOESS, and GOES and the demand for access to these data on the first day of availability, NOAA has requested $3.6 million in the FY 2004 budget request to continue to develop the Comprehensive Large Array-data Stewardship System (CLASS) and an additional $3.0 million to incorporate the NASA EOS data into the CLASS infrastructure.

CLASS is NOAA's integrated enterprise archive architecture and management system that will provide rapid access and long-term scientific stewardship of large volumes of satellite, as well as airborne and *in-situ* (surface: land and ocean), environmental data, operational products, and respond to on-line users' requests. Full funding of these data management activities will help us to prepare for NPOESS and GOES-R data archiving challenges. CLASS is a critical foundation for the scientific data stewardship of NOAA's vast archive, a national treasure and resource. The CLASS program is NOAA's principal avenue to meeting the challenges of rapid advances in information technologies and a much more informed and demanding customer.

We are at a critical juncture in the development of CLASS in order to meet user requirements for NPP and NPOESS. NOAA received $2.9 million in appropriations of the $6.6 million requested in FY 2003 President's Budget Request to develop CLASS and provide the initial capability to include EOS Archive data into the CLASS infrastructure. Full funding of the FY 2004 budget request will allow NOAA to develop the enterprise architecture to ensure the stewardship (access and archive) for the NPP data and to meet the critical requirement of the climate research community.

In conclusion, Mr. Chairman and members of the Subcommittee, NOAA is pleased to have had the opportunity to provide you an update on the GOES-R and NPOESS, and our data management programs. We are actively managing the scheduling and technology risks associated with these systems, and look forward to working with the Congress and the Administration to minimize the funding risks. Support of the FY2004 budget request is imperative to successful development, launch, and operation of the next generation of satellites. The validated, requirements-based data from these systems will vastly improve the health and safety of the people, the U.S. economy, and our global environment. A key element to our strategy is partnering with other agencies, such as NASA and DoD, the space industry, our international partners, and academia. These partnerships have proved to be wise investments for NOAA and the Nation. We have also greatly appreciated the continued support and interest expressed by this Subcommittee.

Mr. Chairman and Subcommittee members, this concludes my testimony. I would be happy to answer any questions.

Appendix 1

National Polar-orbiting Operational Environmental Satellite System Sensors:

- ***Visible/Infrared Imaging Radiometer Suite (VIIRS)***:
  Three orbits, high precision, near constant resolution, multi-spectral imagery (22 "colors").
  - Imagery * [1]
  - Sea*, Ice and Land Surface Temperature
  - Aerosol Particle Size and optical thickness
  - Surface Albedo
  - Cloud cover, layers, particle size, optical thickness, height, and pressure/temperature of tops
  - Ocean color/chlorophyll
  - Precipitable water and suspended matter
  - Sea Ice characterization
  - Surface type and vegetative index

- ***Conically-scanning Microwave Imager and Sounder (CMIS)***:
  Three orbits, imagery through clouds and sounding.
  - Sea Surface Winds*
  - Soil Moisture*
  - Cloud Base Height and Ice/Liquid Water
  - Atmospheric pressure, moisture and temperature vertical profiles (low resolution)
  - Sea, Ice and Land Surface Temperature through clouds
  - Precipitation type and rate
  - Snow cover and depth
  - Atmospheric Total Water Content
  - Surface type and sea ice characterization

- ***Cross-track Infrared and Microwave Sounding Suite (CrIMSS)***:
  Pair of sounding instruments on two orbits (comprised of the Cross-track Infrared Sounder (CrIS) and the Advanced Technology Microwave Sounder (ATMS)).
  - Atmospheric pressure, moisture* and temperature* vertical profiles (high resolution)

- ***Ozone Mapping Profiler Suite (OMPS)***:
  Single orbit of ultraviolet down looking and horizon viewing instruments.

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[1] * Note: Environmental data types with Key Attributes which would require replacement of a satellite if a sensor becomes unable to perform.

- Ozone total column map and vertical profile (Treaty Requirement)

- ***Space Environmental Sensing Suite (SESS)***:
  Collection of instruments to measure ionospheric and electromagnetic space conditions.
  - Auroral Boundary, Energy Deposition and Imagery
  - Electric and Geomagnetic Fields
  - Electron Density and Neutral Density Profiles
  - Energetic Ions and Medium Energy Charged Particles
  - Supra-Thermal-Auroral Particles
  - In-situ plasma temperature and fluctuations
  - Ionospheric Scintillation (in-situ)

- ***Global Positioning System Occultation Sensor (GPSOS)***:
  Ionospheric sounding instruments on one orbit.
  - Electron Density Profile
  - Ionospheric Scintillation (horizon)

- ***Earth Radiation Budget Sensor (ERBS)***:
  Single orbit to record balance of reflected and emitted energy. Used to help model the Earth's energy balance to understand climate.
  - Downward Radiance, long and short wave
  - Net heat flux
  - Net solar radiation, top of atmosphere
  - Outgoing long wave radiation, top of atmosphere

- ***Total Solar Irradiance Sensor (TSIS)***:
  Continuously measures energy from the Sun from a single orbit. Used to help model the sun's energy input to the Earth. With the ERBS, helps understand Earth's energy balance to understand climate.
  - Solar Irradiance

- ***Altimeter (ALT)***:
  Single highly precise radar altimeter.
  - Ocean Wave Characteristics
  - Sea Surface Height/Topography (used to see if the ocean is rising)
  - Wind Stress

- ***Aerosol Polarimetry Sensor (APS)***:
  Single sensor. Measures the distribution and shape of small particles suspended in the air. This gives indications as to source – natural or man-made.
  - Aerosol Optical Thickness, Particle Size and Refractive Index
  - Cloud Particle Size and Distribution

In addition, some satellites carry the following instruments:

• ***Search and Rescue Satellite Aided Tracking (SARSAT)***	-	All satellites
• ***ARGOS Data Collection System (ADCS)***	-	Two orbits
• ***Survivability Sensor (SS) attack warning sensor***	-	All satellites

Three orbital planes are polar sun-synchronous orbits with local ascending node times of **1330**, **1730** and **2130**.

Instruments in 1330 orbital plane:

• VIIRS	• CMIS	• CrIS/ATMS	• OMPS	• SESS
• GPSOS	• ERBS	• SARSAT	• ADCS	• SS

Instruments in 1730 orbital plane:

• VIIRS	• CMIS	• CrIS/ATMS	• ALT
• TSIS	• SARSAT	• ADCS	• SS

Instruments in 2130 orbital plane:

• VIIRS	• CMIS	• APS	• SARSAT	• SS

All satellites can accommodate all instruments. The configuration launched is determined at the time of call-up depending on the operational needs of the environmental satellite data using community.

These strategies allow NOAA to develop and fund these activities at the best cost-benefit to the taxpayer while minimizing the risk of interruption of satellite data.